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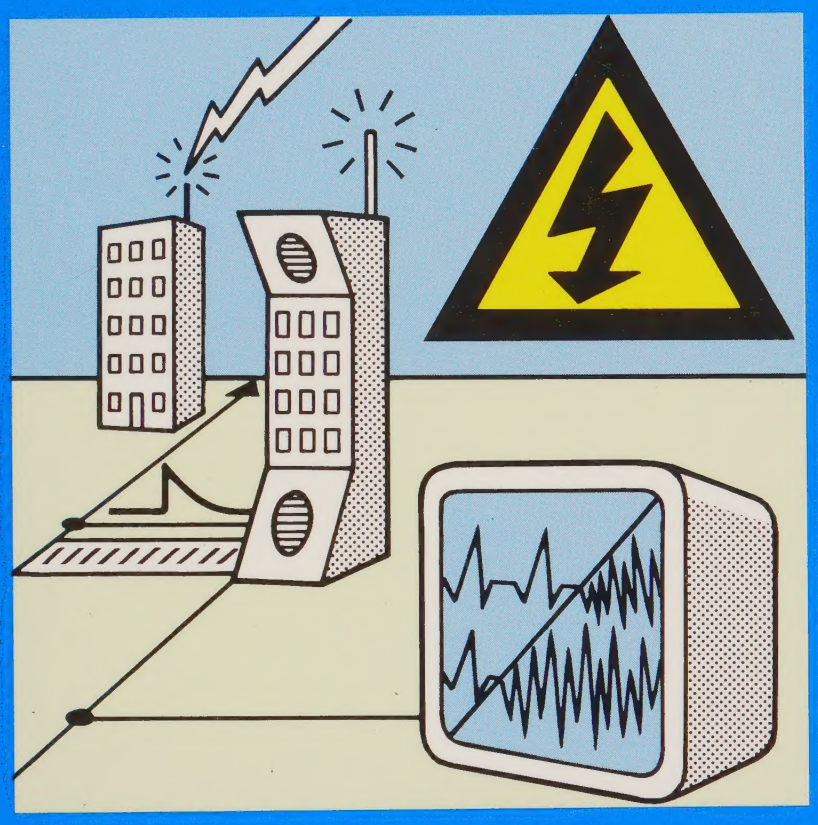
Health Technical Memorandum 2014

Validation and verification

Abatement of electrical interference



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Health Technical Memorandum 2014

Validation and verification

Abatement of electrical interference

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About this publication

Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

Health Technical Memorandum 2014

HTM 2014 gives comprehensive advice and guidance on the current and proposed legal and mandatory requirements placed on medical-electrical equipment used in healthcare premises with regard to electromagnetic interference (EMI).

It outlines:

a. the basics of abatement of electrical/electromagnetic interference;

b. the wide-ranging inadvertent interaction of the physical properties between different items of equipment due to EMI.

Advice is given on methods of measurement and containment of electromagnetic interference, and the design and installation practices for the electromagnetic compatibility of medical-electrical equipment within healthcare premises are reviewed.

It is published as four separate volumes each addressing a specialist discipline:

- **Management policy** – outlines the overall responsibility of managers of healthcare and personal social services premises, and details their legal and mandatory obligations to ensure that all electrical/electronic equipment is purchased and installed in accordance with legal and contractual requirements;

- **Design considerations** – highlights the overall requirements and considerations that should be applied to the design up to the contract document;

- this volume – **Validation and verification** – provides information about the works tests and site tests which have to be carried out to satisfy legal and contractual obligations of the seller and the purchaser. Tests to be done selectively, as required, are listed and the various test instruments are briefly described;

- **Operational management** – simple guidance is given for locating a source of, or the reason for, electromagnetic interference or incompatibility between items of equipment. Guidance is only intended to assist in first-step diagnosis using simple checks and instruments.

Guidance in Health Technical Memoranda is normally complemented by the library of National Health Service Model Engineering Specifications. Users of this guidance are advised to refer to the Statutory Instruments, which outline the standards of manufacture and the obligations of the manufacturer and purchaser.

The contents of this Health Technical Memorandum in terms of management policy and operational policy are endorsed by:

- the Welsh Office for the NHS in Wales;

- the Health and Personal Social Services Management Executive in Northern Ireland;

- the National Health Service in Scotland Management Executive.

References to legislation appearing in the main text of this guidance apply in England and Wales. Where references differ for Scotland and/or Northern Ireland these are given as marginal notes. Where appropriate, marginal notes are also used to amplify the text.

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1.0 Scope

General

1.1 Medical-electrical equipment in healthcare and personal social services premises (HCPs) is liable to be susceptible to electrical interference from:

a. alternating magnetic fields;

b. alternating electric fields;

c. transient voltage changes.

Although distinct types, these interrelate and are generally known as electromagnetic interference (EMI). Electromagnetic compatibility (EMC) is achieved when this interference is eliminated.

1.2 Earlier statutory regulations and British Standards Institution publications dealing with EMI were primarily concerned with preventing various types of electrical equipment (including medical-electrical equipment) from interfering with radio telecommunication services.

1.3 A requirement is now in place for all electrical products, systems and installations not to cause, or be unduly affected by, EMI. The requirement is in the form of an EC Directive on EMC (89/336/EEC as amended by 91/263/EEC and 92/31/EEC). This Directive has been implemented in UK law by the Electromagnetic Compatibility Regulations 1992 (SI No 2372), which came into force on 28 October 1992. Transitional arrangements, until 31 December 1995, are in situ so that member states can continue to allow to be placed on the market, or to be taken into service, apparatus which conforms to the national regulations in force in their territory on 30 June 1992.

1.4 The EMC Directive is not, however, all-inclusive. Apparatus wholly covered by other Directives (for example telecommunication terminal equipment, which has its own specific Directive) is excluded, while medical devices, active implantable medical devices and in-vitro diagnostic devices are, or are expected to be, covered by three specific Directives as follows:

a. active implantable medical devices – 90/385/EEC, UK legislation Active Implantable Medical Devices Regulations 1992 (SI 1992/3146), effective 1 January 1993;

b. medical devices – this is a general Directive on medical devices which was agreed by an EC commission in the summer of 1993 for implementation in January 1995. UK legislation is expected by the end of 1994. A transitional period (during which manufacturers can choose between the old and new systems) will be running until mid 1998;

c. in-vitro diagnostic medical devices – a draft from an EC commission is expected by early 1995.

Definitions

1.5 The following definitions apply throughout this document.

1.6 **Management:** is the owner, occupier, employer, general manager, chief executive, or other person who is accountable for the premises and is responsible

for issuing or implementing a general policy statement under the Health and Safety at Work etc Act 1974.

Health and Safety at Work (Northern Ireland) Order 1978 SI 1979/1039 NI 9.

1.7 Employer: any person or body who:

a. employs one or more individuals under a contract of employment or apprenticeship;

b. provides training under the schemes to which the Health and Safety (Training for Employment) Regulations 1988 (Statutory Instrument No 1988/1222) apply.

Northern Ireland: Health and Safety (Training for Employment) Regulations 1990, Statutory Instrument No 1990/1380.

1.8 Department: an abbreviation of the generic term "UK Health Departments" (Department of Health, the Scottish Office, the Welsh Office and the Department of Health and Social Services Northern Ireland).

1.9 Duty holder: a person on whom the Electricity at Work Regulations 1989 impose a duty in connection with safety.

Electricity at Work Regulations (Northern Ireland), 1991 (SI 191/13) enforcement date 6 January 1992.

1.10 Electrical/electronic equipment: includes anything used, intended to be used or installed for use to generate, provide, transmit, transform, conduct, distribute, control, measure or use electrical energy.

1.11 Equipment: abbreviation of electrical/electronic equipment.

1.12 System: a system in which all the electrical equipment is, or may be, electrically connected to a common source of electrical energy, including such source and such equipment.

1.13 High voltage (HV): the existence of a potential difference (rms value for ac) normally exceeding 1000 volts ac between circuit conductors or 600 volts between circuit conductors and earth.

1.14 Low voltage (LV): the existence of a potential difference (rms value for ac) not exceeding 1000 volts ac or 1500 volts dc between circuit conductors or 600 volts ac or 900 volts dc between circuit conductors and earth.

1.15 Ambient level: those levels of radiated and conducted signal noise existing at a specified test location and time when the test sample is inoperative. Atmospherics, interference from other sources, circuit noise, or other interference generated within the measuring set comprise the "ambient level".

1.16 Antenna-induced voltage: the voltage that is measured or calculated to exist across the open-circuited antenna terminals.

1.17 Broadband emission: emission which has a spectral energy distribution sufficiently broad, uniform and continuous so that the response of the measuring receiver in use does not vary significantly when tuned over a specified number of receiver impulse bandwidths.

1.18 Conducted emission: desired or undesired electromagnetic energy which is propagated along a conductor. Such an emission is called "conducted interference" if it is undesired.

1.19 Cross coupling: the coupling of a signal from one channel, circuit or conductor to another, where it becomes an undesired signal.

1.20 Cross modulation: modulation of a desired signal by an undesired signal. This is a special case of intermodulation.

1.21 Crosstalk: an electromagnetic disturbance introduced by cross coupling.

1.22 Electromagnetic compatibility: capability of electronic equipment or systems to be operated with a defined margin of safety, in the intended operational environment, at designed levels of efficiency, without degradation due to interference.

1.23 Emission: electromagnetic energy propagated from a source by radiation or conduction. This may be intentional or unintentional emission.

1.24 Field strength: the term "field strength" should be applied only to measurements made in the far field. The measurement may be of either the electric or the magnetic component of the field, and may be expressed as volts per metre, amperes per metre, or watts per square metre; any one of these may be mathematically converted to the others.

1.25 Earth plane: a metal sheet or plate used as a common reference point for circuit returns and electrical or signal potentials.

1.26 Impulse: an electromagnetic pulse of short duration relative to a cycle at the highest frequency being considered. Regularly repeated impulses of uniform level will generate a uniform spectrum of discrete frequencies (Fourier components), separated in frequency by an amount equal to the repetition frequency.

1.27 Impulse bandwidth: the peak value divided by the area of the impulse response envelope.

1.28 Impulse emission: emission produced by impulses having a repetition frequency not exceeding the impulse bandwidth of the receiver in use.

1.29 Interference emission: any undesirable electromagnetic emission.

1.30 Intermodulation: mixing of two or more signals in a nonlinear element, producing signals at frequencies equal to the sums and differences of integral multiples of the original signals.

1.31 Narrowband emission: that which has its principal spectral energy lying within the bandpass of the measuring receiver in use.

1.32 NAMAS: a specialist NPL test executive approved under the auspices of the National Measurement Accreditation Scheme to accredit test laboratories to undertake EMC testing.

1.33 Open area: a site for radiated electromagnetic interference measurements which consists of open flat terrain at a distance far enough away from buildings, electric lines, fences, trees, underground cables and pipelines so that effects due to these are negligible. This site should have a sufficiently low level of ambient interference to permit testing to the required limits.

1.34 Radiated emission: radiation and induction field components in space.

1.35 Spurious emission: any electromagnetic emission from the intended output terminal of an electronic device, but outside the designed emission bandwidth.

1.36 Spurious response: any response of an electronic device to energy outside its designed reception bandwidth through its intended input terminal.

1.37 Standard reference output: a condition for a particular test sample that defines normal operation and is used in measuring any deviation from standard performance that occurs during susceptibility testing. This value should be indicated in the individual equipment specification.

1.38 Susceptibility: the characteristic of electronic equipment that permits undesirable responses when subjected to electromagnetic energy.

1.39 Test antenna: an antenna of specified characteristics designed for use under specified conditions in performing tests.

2.0 Commissioning

2.1 EMC testing can be carried out at three levels of assembly:

a. component – which includes black box testing, switches, relays;

b. sub-system – an electronic or electrical equipment that performs a specific function, within an overall system;

c. system – the overall equipment, to ensure that the whole assembly complies with the specification, and that no interrelated or cross-interferences exist between the equipment and/or the environment.

Works testing

2.2 The electronic and/or electrical equipment should be tested and demonstrated as a complete operational unit where possible. RF emission from any electrical equipment should be determined, and at the same time its level of susceptibility to any external influences that may be generated around the works.

2.3 At the time of contract the operational use and the location of use of the equipment must be made known by the purchaser to the manufacturer. A certificate of guaranteed electromagnetic compatibility must be obtained for the electrical equipment either as per the EC Directive on EMC (89/336/EEC) or the Directive on medical devices 90/385/EEC.

2.4 The EMC test environment should simulate the environment/location in which the equipment will be required to operate, and may also include transmitting stations, vehicular devices, mobile communication units and diathermy apparatus.

Site testing

2.5 Before in situ operational tests or demonstrations are carried out on the electrical equipment to be installed, it is essential that two phases of a 3-phase supply are available. The test equipment and the monitoring equipment must not be on the same phase of supply or else suitable arrangements must be made to isolate this equipment. The screening of the location from outside RF sources of emission must be in place.

2.6 Aggressive electromagnetic radiation and power supply interference must be measured to determine the suitability of the location for the electrical equipment, or whether radiation screening or electrical supply filtering may be necessary.

2.7 Where screening or filtering may be necessary the cost of such requirements must be assessed and carefully balanced against the cost of a new location.

2.8 A basic list of electromagnetically compatible location requirements may include the following:

- power ring main and lighting supply wires screened and enclosed in isolated metal conduit which is earthed at point of entry to the location;
- socket boxes are metal enclosed;

- fluorescent light fittings metal screened. Incandescent lighting is interference free;
- power and lighting supply mains filtered;
- a dedicated protective earth system of low impedance should be available.

RF radiation screening

2.9 The following methods can be adopted:

a. the walls and ceiling can be covered with screening material;

b. window openings can be covered by a screen mesh;

c. resonant frequency of the room can be determined, with and without electrical equipment installed;

d. ventilation duct openings can be covered by honeycomb screens;

e. the use of radio frequency absorbent materials should be considered.

Legal test requirements

2.10 As per the EC Directives all items of equipment are to be electromagnetically compatible both in terms of emissions (generation of undesired electromagnetic energy) and immunity (adverse reaction to the presence of undesired electromagnetic energy).

2.11 The range of electrical apparatus found in healthcare and social services premises means that, in order to meet the requirements of the EMC Directive, a number of harmonised standards will apply. For example, refrigerators and microwave ovens will be required to meet the appropriate product specific standards or, in the absence of these, the generic standards for domestic, commercial and light industry.

2.12 Diathermy apparatus will be required to meet the product specific standards for industrial, scientific and medical equipment.

2.13 Computing devices will require to be manufactured to the product specific standards required for information technology equipment.

2.14 The proposed family of Directives for medical devices may lead to the identification of a set of harmonised standards that are applicable to healthcare and social services premises; nevertheless, these will be based on the essential requirements of the EMC Directive.

2.15 Achieving conformity with the EMC Directive presents a number of technical and commercial problems. The technical problems include identification of the appropriate standard and deciding the route to conformity. Commercial problems include the cost of meeting the requirements and the timing of actions leading to conformity.

2.16 The use of harmonised standards in full enables the manufacturer to demonstrate conformity with the protection requirements of the EMC Directive. A list of currently available and proposed harmonised standards is given in paragraph 1.4 of this volume.

2.17 Where the manufacturer has not fully applied a harmonised standard, or where such standards do not exist, the manufacturer must draw up a technical construction file which enables the conformity of the product to be assessed. This file is verified by a NAMAS or EC accredited laboratory of the manufacturer's choice.

3.0 EMC test objectives and plan

3.1 In order to achieve EMC effectively and economically it is essential that the EMI threat is considered fully at all stages of design, development, manufacture, installation and maintenance. The implementation of curative measures at a late stage, or retrospectively, will almost inevitably result in considerable extra effort and cost, and, not least, inconvenience to both supplier and user.

3.2 It is therefore essential that the EMC design goals are established at an early stage preferably before the contract, and an EMC plan is agreed and implemented for all stages. For a fairly simple item of equipment this may involve minimal effort whereas for a large sophisticated system all EMC related aspects must be documented.

Procurement requirement

3.3 The following questions are relevant:

a. Is the requirement clearly understood?

b. Is the equipment to be installed in a defined/controlled area?

c. Does the minimum EMC Directive requirement apply?

d. What is the defined purpose of the equipment?

e. What levels of interference exist in the equipment's external environment?

f. What levels of interference are being created by co-sited equipment?

g. How much allowable interference can be generated by the equipment without threatening co-sited equipment?

These questions will give a prediction of the vulnerability and annoyance factors of the equipment to be procured and will allow the designer to choose the correct technology components and design for optimum performance of the equipment.

Specification

3.4 Is the classification of the equipment correctly stated so that the correct set of EMC specifications and tests can be applied?

Control plan

3.5 The following questions are relevant:

a. Are the lines of responsibility for the implementation of EMC established?

b. Are the definitions and relevant documents identified and available?

c. Have all the relevant mechanical design aspects been considered?

d. Have all the electrical design aspects been covered?

e. Have all the installation practices been identified?

f. Has the test strategy been established?

g. Are the production and maintenance controls in place?

h. Has sample testing during production been carried out?

Test plan

3.6 The test plan is the most accurate way of agreeing the requirements applicable to the equipment. The test plan may include one or more of the representative procedures:

- a description of equipment for test;
- a statement of test objectives;
- the criteria for determining the equipment or parts to be monitored;
- test requirements which should include frequency ranges, test equipment to be used, exact points of measurement and the various modes of operation;
- test procedure to be followed;
- chain of command;
- type of test report;
- any methods required to evaluate the test results.

3.7 The involvement of the above procedures will be dependent upon the importance placed upon the assembly level, and the sensitivity of the equipment under test.

Test report

3.8 This should accurately detail all the test results and measurement uncertainties and link across to the test plan.

Interference simulation tests

3.9 Interference voltages and electromagnetic fields at desired frequencies can be superimposed upon input signals or power supplies or equipment bodies. Special equipment is required for these tests and the tests are preferably carried out at a third party test house or the manufacturer's works in the presence of the management's approved representative.

3.10 The range of tests required must be specified in the contract document and a certificate of satisfactory performance provided, stating type test and routine test before delivery can be accepted and authorised by the management representative. Depending on the classification of the equipment, all apparatus must be endorsed with the EC conformity 'CE' mark as described in HTM 2014 – 'Management policy', paragraph 2.19.

3.11 The test equipment must be sufficiently flexible to demonstrate that the equipment under test is immune to interference for the use intended. Certain critical parameters should be chosen on which to monitor equipment susceptibility.

3.12 The test equipment will be required to simulate one or more of the following tests:

a. power failures or interruptions originating within the switching system, or supply over or under voltage changes;

b. interference pulses on power lines – high energy and slow risetime (300 nanoseconds (ns)) generated when switching large inductive or capacitive loads, medium energy and medium risetimes (35 ns) generated by the operation of fast power switching devices. Low energy and fast risetime (5 ns) generated through switches and relays;

c. simulation of electrostatic discharge to the equipment;

d. high voltage – for insulation soundness and determination of insulation leakage current;

e. electromagnetic fields to simulate hostile radiated interference.

3.13 The EMI emissions generated within the equipment must also be measured, to assess the degree of interference generated by the equipment:

a. measurement of electromagnetic voltage and current, and power on power and signal lines;

b. measurement of the electric and magnetic components of the electromagnetic energy generated by the equipment.

Radiated emissions measurements

3.14 For some types of electrical equipment, such as diathermy, RF emissions can only be effectively assessed on the basis of the radiated field.

3.15 To assess the degree of interference, an open test site should be chosen, with the aggressor equipment transmitting to the susceptible receiving equipment from known distances. The open site may be a special site where secondary reflection/transmission emissions are eliminated or a practical site where reflection may be present off the site infrastructure.

3.16 The second test measurements should be repeated with and without the aggressor equipment in the actual location of operation.

3.17 The RF measurements are generally made using two methods. Up to 30 MHz the RF voltage at the mains terminal is measured as a conducted interference test and above 30 MHz generally up to 1000 MHz, by measurement of the radiated energy in field strength in V/m.

3.18 Care should be taken when making on-site measurements of radiated fields in rooms that are not "damped" with radio absorbent material. The room, whether screened or not, may have a resonant frequency dependent upon the physical dimensions and the equipment within the room. Tests should be made to ensure that this frequency is not within the susceptibility range of the equipment under test or the same range of other victim equipment in another location. The tests should be carried out firstly with the room empty in order to characterise the ambient condition and afterwards with the room occupied by equipment.

3.19 The resonant frequency may be damped by the use of RF energy absorbent cones suitably placed around the sides and ceiling of the room.

Electrostatic discharge

3.20 The incidence is very much increased firstly by the excessive dryness in the air, that is, a more resistive path for an electron charge to dissipate, and secondly the ease in which charge may be induced by man-made fibres, as opposed to the more moisture absorbent natural fibres.

3.21 The tests have now been described in BS6667 Part 2 (IEC 801 Part 2). A high voltage probe tester designed for simulating an electrostatic discharge is applied to the various parts of an item of equipment. The voltage control range for tests recommended is between 2 and 15 kV with risetimes of normally five nanoseconds ±30% depending on the specification applied. Equipment is now available which can apply test voltages with less than one nanosecond risetime up to 8 kV.

4.0 Test equipment standards

4.1 A range of equipment is available to carry out the whole range of simulated interference tests covered in this HTM. Each item of test equipment is a specialised and complex design, and will therefore lie beyond the economical or practical requirements of an HCP. Investigation of EMI problems involve the measurement of complex waveforms. The instruments for emissions test purposes, operate in the frequency domain and are based on radio receiver designs where the peak, quasi-peak and average interference values can be measured.

4.2 Full details of performance and design parameters for radio interference measuring receivers are given in BS727:1983 and CISPR publication No 16.

Test site

4.3 An open field site or screened room with RF absorbers, that is, anechoic chamber, may be used for testing the susceptibility of an item of equipment under test to electromagnetic transmission. In an open field site the distance between the test antenna and the equipment under test may range from 2 m to 30 m. The site is arranged to precise elliptical dimensions with a uniform earth plane. A suitable site should be able to operate over a frequency range 25 MHz to 1000 MHz. The screened room should be used for immunity testing so that the external ambient cannot be influenced.

Spectrum analysers

4.4 Spectrum analysers are used in a variety of EMC investigatory tests principally for detection of the harmonics generated from non-sinusoidal waveform generators and digital signals. The instruments can be manually operated or have automatic sweep scan control over the operating frequency range. They are not as accurate as radio receivers designed for the accurate measurement of electromagnetic phenomena.

Measuring receiver equipment (MRE)

4.5 The MRE may be semi-automatic or manual with a display equipment and a X-Y plot recorder. MRE are generally superheterodyne receivers which are more suited for accurate measurements than for investigatory testing (spectrum analysers are more versatile but generally not as accurate).

Power line impedance stabilising networks

4.6 A line impedance stabilisation network (LISN) of suitable impedance (50 ohms/50 μH) should be provided for presenting a known constant impedance between the supply and the equipment.

The equipment under test and the test equipment must be fed from different single phases of a common 3-phase supply, or suitably isolated from each other.

Signal generators

4.7 The signal generator must possess sufficient output in conjunction with power amplifiers to provide the required field strength meter reading for immunity testing over the required frequency range.

Antennae

4.8 The antennae are generally dipoles arranged in horizontal or vertical configuration or looped antennae for magnetic fields.

Current injection probes

4.9 This is generally a portable instrument that injects a representative interference signal into any connecting power cable of an electronic equipment under test thus providing an instant assessment of the vulnerability of the equipment under test to RF. This instrument generally operates over a wide spectrum with amplitude and frequency modulated signals at an output of 50 mW, 100 mA. This is a basic instrument which simulates the interference current flow in a conductor thus highlighting a potentially susceptible defect.

Mains supply interference simulators

4.10 The adaptability of these simulators can vary in the range of tests they are designed to perform. The unit may comprise a central control unit, plus an additional feature of plug-in mainframe units, to control the simulation of mains failures and interference pulses generated in system operations normal/abnormal behaviour as follows:

a. pulses: medium to fast 5/100 ns to 35/3000 ns;

b. dropout times, within $\frac{\lambda}{2}$ wave;

c. dropout time within a wave train and phase delay;

d. voltage wave amplitude variation;

e. repetitive bursts of pulses, less than 2000 V, 0.1 Hz up to 10 kHz, or greater than 2000 V, 0.1 Hz up to 5 kHz;

f. standardised lightning voltage pulse and surge current, 1.2/50 microseconds and 8/20 microseconds respectively;

g. high voltage test range 100/5000 V ac, 100/1000 V dc and equipment leakage current.

Magnetic field meter

4.11 The magnetic field meter is an instrument to measure low frequency magnetic fields. The main features of the instrument are:

a. orthogonal coils, independent of field direction;

b. frequency range (5 – 1000 Hz) for all low frequency magnetic fields;

c. wide dynamic range 0.01 – 1000 microTesla with auto-ranging;

d. true RMS flux with dominant frequency measurement;

e. polarisation measurement and presentation;

f. flexible data logging functions with the possibility to transfer stored results to printer or computer;

g. battery powered to avoid any power supply interferences.

5.0 Supervision

5.1 EMC tests to equipment are not usually carried out on site. Every endeavour should be made to ensure that the items of equipment are tested initially in the manufacturer's works or at an accredited NAMAS or EC test laboratory to ensure the representative environmental conditions for test are met. "CE" conformity labels and manufacturers' installation procedures must be supplied.

5.2 In cases where equipment is large and requires building on site into fixed positions then the highest standard of test equipment must be used. Management representatives, with the best understanding and knowledge of the required test procedures and test routines, must be witnesses. A manufacturer must be fully informed of the purpose and the function of the equipment under test, and given a full specification of the operating expectations of the equipment at the specification stage.

5.3 A written guarantee must be part of the acceptance for completion of works. For tests to be smoothly and quickly carried out to a satisfactory conclusion, electrical services and other piped systems must be completed and in place, as allocated by the project management. Extra test services required must be stated by the manufacturer, as part of his tender for the contract, not at the time of arrival on site to carry out tests.

Other publications in this series

(Given below are details of all Health Technical Memoranda available from HMSO. HTMs marked (*) are currently being revised, those marked (†) are out of print. Some HTMs in preparation at the time of publication of this HTM are also listed.)

1 Anti-static precautions: rubber, plastics and fabrics*†
2 Anti-static precautions: flooring in anaesthetising areas (and data processing rooms)*, 1977.
3 –
4 –
5 Steam boiler plant instrumentation†
6 Protection of condensate systems: filming amines†
7 Electrical services: supply and distribution*†
8 –
9 –
10 Sterilizers*†
2011 Emergency electrical services, 1993.
12 –
13 –
15 Patient/nurse call systems†
16 –
17 Health building engineering installations: commissioning and associated activities, 1978.
18 Facsimile telegraphy: possible applications in DGHs†
19 Facsimile telegraphy: the transmission of pathology reports within a hospital – a case study†
2020 Electrical safety code for low voltage systems, 1993.
2021 Electrical safety code for high voltage systems, 1993.
22 Piped medical gases, medical compressed air and medical vacuum installations*†
22 Supp. Permit to work system: for piped medical gases etc †
23 Access and accommodation for engineering services†
24 –
25 –
26 Commissioning of oil, gas and dual fired boilers: with notes on design, operation and maintenance†
27 Cold water supply storage and mains distribution* [Revised version will deal with water storage and distribution], 1978.
28 to 39 –
2040 The prevention of legionellae in healthcare premises – a code of practice, 1993.
41 to 53 –

Component Data Base (HTMs 54 to 70)

54 User manual, 1989.
55 Windows, 1989.
56 Partitions, 1989.
57 Internal glazing, 1989.
58 Internal doorsets, 1989.
59 Ironmongery, 1989.
60 Ceilings, 1989.
61 Flooring, 1989.
62 Demountable storage systems, 1989.
63 Fitted storage systems, 1989.
64 Sanitary assemblies, 1989.
65 Signs †
66 Cubicle curtain track, 1989.
67 Laboratory fitting-out, 1993.
68 Ducts and panel assemblies, 1993.
69 Protection, 1993.
70 Fixings, 1993.
71 to 80 –

Firecode

81 Firecode: fire precautions in new hospitals, 1987.
81 Supp 1,1993.
82 Firecode: alarm and detection systems, 1989.
83 Fire safety in health care premises: general fire precautions*†
85 [Revision to Home Office draft guidance in preparation]
86 Firecode: assessing fire risks in existing hospital wards, 1987.
87 Firecode: textiles and furniture, 1993.
88 Fire safety in health care premises: guide to fire precautions in NHS housing in the community for mentally handicapped/ill people, 1986.

New HTMs in preparation

Lifts

Combined heat and power

Telecommunications (telephone exchanges)

Washers for sterile production

Special ventilation systems

Risk management and quality assurance

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About NHS Estates

NHS Estates is an Executive Agency of the Department of Health and is involved with all aspects of health estate management, development and maintenance. The Agency has a dynamic fund of knowledge which it has acquired during 30 years of working in the field. Using this knowledge NHS Estates has developed products which are unique in range and depth. These are described below.

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Health Technical Memorandum 2014

Abatement of electrical interference
Validation and verification

Department of Health

Scottish Office

Welsh Office

Department of Health
and Social Services
Northern Ireland

Health Technical Memorandum 2014 supersedes HTM 14 of the same title published in 1965. It gives comprehensive advice and guidance on the current and proposed legal and mandatory requirements placed on medical-electrical equipment used in healthcare premises with regard to electromagnetic interference (EMI).

It is published as four separate volumes.

This volume – 'Validation and verification' – provides information about the works tests and site tests which have to be carried out to satisfy legal and contractual obligations of the seller and the purchaser. Tests to be done selectively, as required, are listed and the various test instruments are briefly described.

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